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# MAN-MADE AURORA OF THE PLANET EARTH

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# **MAN-MADE AURORA OF THE PLANET EARTH**

**SHIGEHISA NAKAMURA**

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## PREFACE

This work concerns to a problem on the course of the natural process on the planet earth in the solar system. It is hard to consider any processes found on the earth except considering the planet earth under the influence of the solar effects.

The classical dynamics is essential to consider the processes on the earth are controlled by the sun. First, a brief note is introduced on the solar activity and sun-spots number. This is important to see this work in relation to what are the important factors, though it is necessary to write here that the key of “relativity” and “quantum mechanics” was obtained by the pioneers on the bases of the knowledge on “classic dynamics.

Recently, the scientific publications in the United States have introduced some notes on the man-made aurora appeared after a nuclear test above the atmosphere of Hawaii. Some note is related to an identified spherical thermal dome in the atmospheric layer on the earth surface.

The author here introduces some basic factors to the aurora as the natural process on the planet earth under the effect of the solar winds. In this work, the author aims to introduce a key to promote researches related to the problems for in the next step to the future.

The second part of the contents in this work is consisted by several notes about thermal dome appeared in the sea surface, in the atmospheric layer and above the atmosphere. This closely concerns on explosive thermal energy release after the nuclear processes in the past. This part concerns simply on thermal radiations but electromagnetic radiations.

The author knows that this work is not complete in a scope of modern science, nevertheless he has to feel it to write them down to declare what the author has had considered on his way to promote his scientific work. He believes that the knowledge of our scientific research work is advancing now. We have to start to get the key for advancing to the future science for sustainable background at the human activity on the earth as a planet.

Unfortunately, the author has only a limited knowledge on physics which has been developed by many scientists by this time as seen in a historical review of the related research works.

Hence, the author here introduces his expect for you to obtaining a key to the next step of science at this stage.

The author has had ever given several keys for geophysics, i.e., meteorology, ocean sciences, geomagnetism, seismology, geology, and the related fields in science.

This work is only for obtaining a key to the next advanced step of science.

Now, the author wishes that all of the advanced science as fruits should be helpful for the human activity and human welfare in the next age.

Lastly, the author has to notice that this work is a part of the research project started in Kyoto University during his stay time in the campus. The author has continued his work successively as a part of the extensive research work in relation to the project.

## 著者からの一言

これは、表題が、英文で、“MAN-MADE AURORA OVER THE OCEAN” となっています。日本語で言えば、さしずめ、“洋上の人工オーロラ”ということになるであろう。ところで、このオーロラは、地球の極に近い高緯度に現れる現象であることとなっています。北緯 60 度位で見ることのできる不思議な現象とされている。

しかし、この本文は、表題から予想されるかもしれないようなフィクション小説と違います。人工のオーロラが、赤道に近い亜熱帯で、人工的に発生して、停電などの障害を起すおそれもあることを書いたものです。あるいは、さらに、人類にとって危険な状態が発生する可能性があるかも知れません。

オーロラは、人類の棲家である地球と、地球上のあらゆる生物のエネルギー源である太陽との相互作用によって、出現するものです。自然のオーロラは、北極と南極の高緯度帯(およそ 60 度付近の環状帯)に出現します。地理的条件から、高緯度に位置する大学および研究施設による研究成果が主要なものとなっています。

地球の中緯度帯において、太陽活動が、静穏なときには、太陽は地球に光をそそぎ、さらに、紫外線や赤外線などの影響を及ぼします。太陽活動の変化は、太陽表面に現れる黒点の変化と関係がありますが、その詳細については、現在、世界中の科学者による研究が進められているところです。ただ、歴史時代の資料や最近の観測記録から、およそ 11 年周期の太陽活動の変化があることが知られています。

北緯 60 度くらいで見られるオーロラは、太陽の活動によって、時々刻々、変化しています。これと同様に、南緯 60 度くらいの南極大陸付近でも、オーロラが現れます。このいずれも、太陽風の影響によるといわれています。

その太陽の内部では、水素原子の核融合とヘリウム原子の核分裂との繰り返しによって、エネルギーの放出と消費とを繰り返しています。太陽の表面では、その繰り返しのほかに、電磁氣的現象が現れて、地球に影響して、磁気嵐を起こし電波通信に障害が発生することもあります。また、発電所や変電所の送電機能を妨げ、停電となることもあります。

地球内部では、ある種の原子の崩壊が認められ、これが、地球内部エネルギーの一部となっています。そのほかに、地球上で、人工的に、ある種の原子の崩壊を発生させ、そのエネルギーを利用する例もあります。

太陽の磁気の地球への影響は、太陽風によるとよばれ、実際の地球の磁場は、地上の磁石の例とは異なっています。日常は、オーロラが、静かで美しい世界をつくっていますが、磁気嵐が原因で、地球の低緯度まで、赤いオーロラが見えることもあります。このオーロラのまわりには、プラスのイオンとマイナスのイオンとがあって、プラズマという状態がみられます。これは、太陽と地球との相互作用によるものです。これを利用できれば、地球の直径の何倍も大きな発電機ということになるでしょう。

まだ、本文では、わからないことが、まだ、たくさんあると思います。これから、少しずつ、わかることになるでしょう。わからないことを調べてみようという考えかたもあります。これは、科学の発展を考えると、もっとも大切なことです。ただ、漠然と、発明や発見をしようとしても、ものまねになってしまうでしょう。この本文が役に立てば、うれしいことです。

(著者－ 中村重久)



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## **1. SUN AND EARTH — SOLAR ACTIVITY**

### **(1) LUNAR SHADOW AT SOLAR ECLIPSE**

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# LUNAR SHADOW AT SOLAR ECLIPSE

**Shigehisa Nakamura**  
Kyoto University, Japan

**Abstract**— This an introduction to a satellite monitoring of the lunar shadow tracking on the earth surface at the predicted solar eclipse. One of the specific events is the one on 22 July 2009 in the low latitude zone of the western Pacific. A brief notice is given in relation of the solar eclipse on the planet earth in a scope of geophysical science.

## 1. INTRODUCTION

This is an introduction to a satellite monitoring of the lunar shadow tracking on the earth surface at the predicted solar eclipse. This is a part of the extensive research work at the Shirahama Oceanographic Observatory, Kyoto University. The project was started in 1960. For this project an offshore fixed tower was settled in the northwestern Pacific after one of the project leaders, Professor Shoitiro Hayami of Geophysics, in Kyoto University. Professor Hayami had ever been a member of the observation group for a solar eclipse on an island, Losop Island, in the north western Pacific in an early year around 1930.

In advance of the 50years Anniversary of “the Shirahama Oceanographic Tower”, we had a chance for the satellite monitoring of the solar eclipse. This is the first time of the satellite monitoring of the predicted solar eclipse on the earth surface.

On 22 July 2009, the solar eclipse track passed just neighbor of the Japanese Islands. This solar eclipse might be a tiny impact to “the geophysical processes on the earth” now.

After reviewing the history of human activity on the earth, we can aware that the processes on the planet earth have been governed in the solar system.

Essentially, research on the “Solar Eclipse” has been promoted in the fields related to the section of “Astronomy”. Hence, it should be raised as an interdisciplinary research on the solar activity in relation to the global processes on the earth.

The author here introduces a notice to the solar eclipse observed on the earth after his idea for a satellite monitoring of a solar eclipse in a scope of his interests.

## 2. SATELLITE MONITORING

In this work, the author introduces first some note to the lunar shadow on the earth surface at the solar eclipse. As a special reference, the event of the solar eclipse on the date of 22 July 2009 is taken for his convenience. The reference data was obtained by the satellite GMS-2 which has been operated on a synchronized orbital motion with the earth at the height of 800km just above the earth’s surface on the equator.

The satellite GMS-2 is operated for the purpose of monitoring the various geophysical processes on the earth. A sensor mounted on the satellite has a function to send us about the information of the various geophysical processes including the radiations out of the earth radiation. The author concentrated his interest in this work to the data of the earth surface pattern monitored as a passive signal in the visible band of the solar radiation reflected on the earth surface and of the earth radiation out of the earth surface.

As for the temperature, it is described in an accuracy of 0.5 degree C. The author has a wish to have the interested date in a form of an accuracy of 0.1 degree C In order to have

a more detailed pattern as a reduced result from the satellite monitoring data.

By this time, the author has worked to see what satellite thermal pattern on the ocean surface or the land surface could be obtained in the infrared band of the radiation out of the ocean surface or the land surface.

The data of the satellite GMS-2 is successively processed and distributed through the Web-site by the Japanese Meteorological Agency as the service for public and citizen uses.

The resolution of a pixel size in an imagery of the earth surface pattern is about 4km square. Nevertheless, we have to be aware of some restriction at utilizing the data obtained by the satellite GMS-2. Some part of the data should be strictly processed after the exactly assured reference of the data.

### 3. PREDEICTED SOLAR ECLIPSE

Each one of the solar eclipses is predicted properly by the National Astronomical Observatory, Tokyo to issue every year in the series of the annual publication as the "Chronological Scientific Tables", which is available for the public and citizen use as well as the scientists in the related fields to the astronomy and geophysics. The edition No.82 of this Table is for 2009.

In Figure 1, an illustration of the lunar shadow zone on the earth surface at the event on 22 July 2009 is introduced in a modified form of the original 2009 issue of the National Astronomical Observatory.

Main shadow zone is shown along an expected line track. Shadow zones at the start and at the end of the solar eclipse are also shown by the distorted circle as a projection of the main and sub shadow zones covering the interested zones.

As for the main solar eclipse shadow, the astronomical prediction about the solar eclipse on 22 July 2009 could be specified by the factors related to the main shadow, that is to say, to indicate the location and time of the solar eclipse shadow. After the evaluation by the National Astronomical Observatory, the specifying data set is given as follow;

	Time (JST)	Location
Start of partial ecliptic shadow	2009 July 22/ 08h 58.3m	84 43' E/ 19 03'N
Start of main ecliptic shadow	2009 July 22/ 09h 52.8m	70 31' E/ 20 21'N
Meridional Center (Concentric)	2009 July 22/ 11h 33.0m	143 22'E/ 24 37'N
End of main eclipse shadow	2009 July 22/ 13h 17.8m	157 41'W/ 12 55'S
End of partial ecliptic shadow	2009 July 22/ 14h 12.4m	171 51'W/ 14 14'S

At the time of the meridional center, a bright ring of the solar beam is formed by the fringe (4%) of the sun.

### 4. TRACKING OF SOLAR ECLIPTIC SHADOW

A data set for the solar eclipse shadow on the earth surface was issued as a special data set through the Web-site by the Japanese Meteorolglcal Agency.

The data set consist the northern hemisphere as a synthesized foot print of the monitoring sensor of the satellite GMS-2 to demonstrate the movement of the solar ecliptic shadow pattern in a step of 15min from the time of 0900-JST to 1400-JST. The data is simply distributed the solar ecliptic shadow pattern reduced after processing the signal radiation for the visible band which was monitored by the sensor mounted on the satellite GMS-2.

The solar ecliptic shadow pattern could be seen along a path projected on the earth following the factors shown above to specify the solar eclipse event. Nevertheless, the

cloud distribution was the contaminating factor at seeing the solar ecliptic shadow.

With the author's experience of the daily pattern of the earth surface, especially, of the ocean surface, the author found that the shadow pattern reduced after processing the earth radiation of the visual band is coarsely consistent to the astronomical prediction.

It was unfortunate this time that no data was supplied for the reduced pattern in the infrared band. So that, it is expected what thermal pattern was obtained in the shadow zone at the interested solar eclipse event to the details in the successive work.

## 5. CONCLUSIONS

A satellite monitored solar eclipse shadow on the earth was introduced. This time, the available data was the radiation in the infrared band reflected on the earth surface and radiated out of the earth surface. The data was obtained by the satellite GMS-2.

The astronomical prediction of the solar eclipse on 22 July 2009 was consistent to the reduced result after processing the data of the satellite monitoring of the radiation in the visible band.

It should be encouraged to promote a research on the thermal pattern at an event of the predicted solar eclipse by a satellite monitoring of the solar eclipse.

Referring to the data obtained and monitored by the satellite, the special and timely pattern of an interested solar eclipse shadow can be seen to help for realizing a more detailed knowledge of an environmental and the other geophysical processes instead of the limited numbers of the discrete local observations obtained on the earth surface in the past.



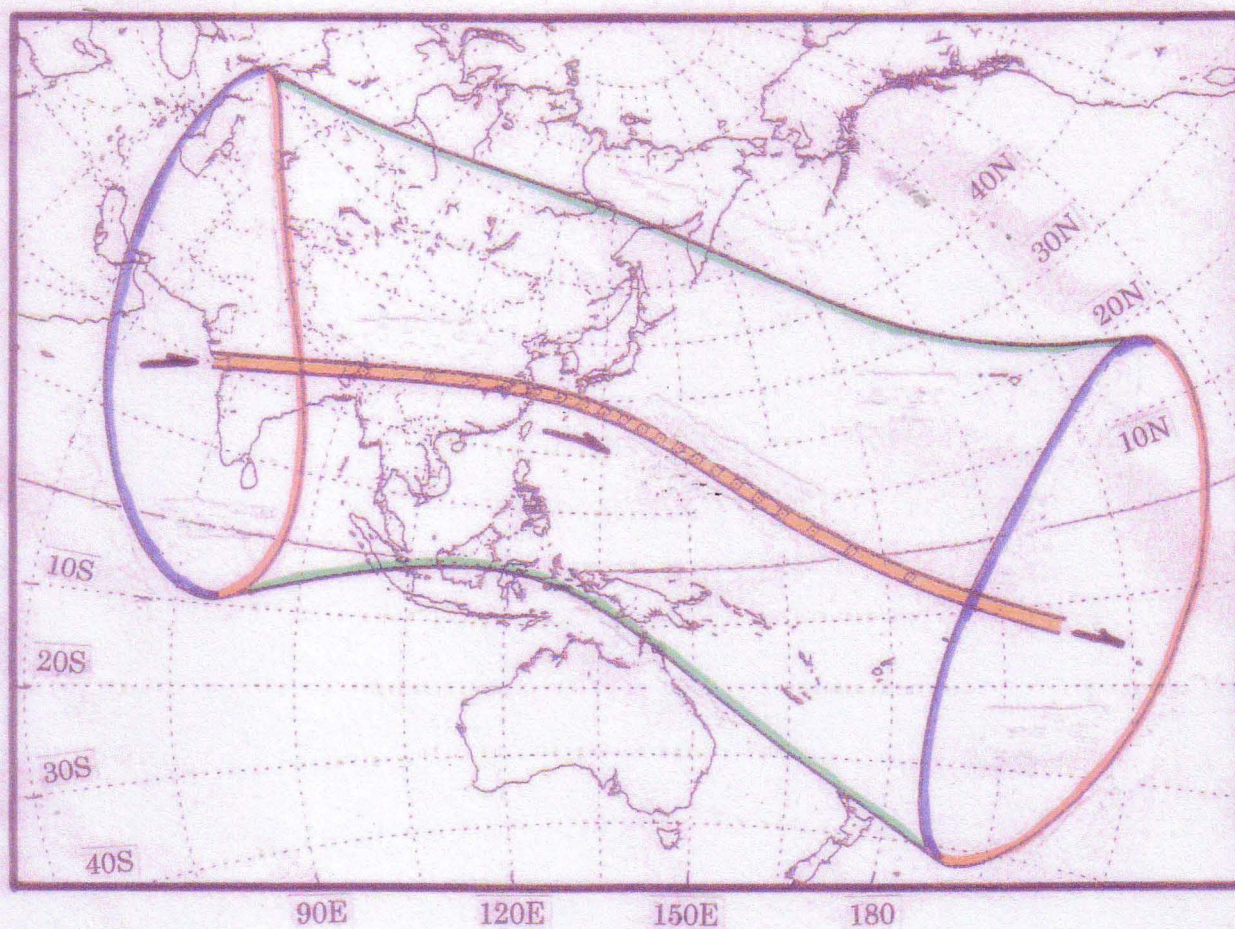


Figure 1 Solar eclipse shadow belt on the earth surface  
On 2009 July 22.  
(Refer to the National Astronomical Observatory)

1. Orange color line for the main shadow belt zone
2. Red color line at each case of the west and east parts  
for the start of the solar eclipse at sun rise and at sun set
3. Blue color line at each case of the west and east parts  
For the end of the solar eclipse at sun rise and at sun set
4. Green color lines for the northern and southern limits  
of the sub-shadow belt centering the main shadow zone
5. Arrows (in black color mark) shows the shadow movement  
with the time elapse.



# A MODEL OF THE 11 YEAR SOLAR CYCLE

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**Abstract**—This is a note concerning a significant trend of the 11 year cycle in the solar activity. The monitored solar cycle for about 100 years has been studied by the scientists in order to develop a numerical model for the solar cycle in a scope of dynamical electromagnetism. This solar cycle model could be a key to an answer at considering any one of the geophysical processes on the planet earth.

## 1. INTRODUCTION

This is a note to help a significant trend of the 11 year cycle in the solar activity. The monitored solar cycle for about 100 years is studied by an approximated model in order to understand a specific property of solar activity in a scope of dynamical electromagnetism. Chapman[1, 2] and Stix[3], for example, noted the early state of the researches related to the solar cycle and solar activity specified by the sun spots number index in an annual time unit. This solar cycle model could be a key to an answer at considering any one of the geophysical processes on the earth as a planet in the solar system.

## 2. MAXWELL EQUATIONS

In order to start for studying solar cycle, Maxwell equations are introduced first for the magnetic field  $B$ , the electric field  $E$ , and the electric current density  $j$ , i.e.,

$$\operatorname{div} B = 0, \quad \dots\dots\dots(1)$$

$$\operatorname{curl} B = \mu j, \quad \dots\dots\dots(2)$$

$$\operatorname{curl} E = -(\partial / \partial t)B, \quad \dots\dots\dots(3)$$

where, the mark  $\mu$  is the magnetic permeability (for free space, in this case). In equation of (2), an approximation is assumed for non-relativistic, or slow phenomena (neglected the displacement current).

When the field is in a material with electric conductivity  $\sigma$ , the current is  $\sigma$  times the electric field (known as Ohm's law). When the material is in motion, it is taken into account of that the law valid in the co-moving frame of reference (i.e.,  $j = \sigma E$ ). In a case of motion (say,  $v$  for  $v \ll c$ ), transformation to the frame at rest is as  $j = j$  and  $E = E + vx \times B$ . Then,  $J = \sigma (E + vx \times B)$ . Eliminating  $E$  and  $j$  in the above equations, the induction equation is written as

$$(\partial / \partial t)B = \operatorname{curl}(vx \times B) - \operatorname{curl}(\eta \operatorname{curl} B), \quad \dots\dots\dots(4)$$

where, magnetic diffusivity is  $\eta = 1/(\mu \sigma)$ .

### 3. MEAN-FIELD ELECTRODYNAMICS

The solar cycle could be solved referring essentially to the Maxwell equations for the magnetic field  $B$ , the electric field  $E$ , and the electric current density  $j$  [1]. Then, an induction equation is reduced. Electric conductivity of the sun could be determined as that of the ionized gas (or plasma) following to Spitzer(1962). For the case of the dynamo problem in terms of a mean magnetic field,  $B=[B]+b$ , where  $[B]$  may be understood as an average over longitude or, more generally, as an ensemble average. Then,  $[b]=0$ . In a same way,  $v=[v]+u$ . Substituting these two into the induction equation, fluctuating part is obtained after separating the mean part.

Following Moffatt(1978) with some assumptions, the mean part  $[B]$  and the fluctuating part  $b$  can be separately described, i.e.,

$$(\partial / \partial t) [C] = \text{curl} ([v] \times [B] + \mathcal{E} - \eta \text{curl} [B]), \dots\dots\dots(5)$$

$$(\partial / \partial t) b = \text{curl} ([v] \times b + u \times [B]) + G - \eta \text{curl} b, \dots\dots\dots(6)$$

where,  $\mathcal{E} = [u \times b]$ , and  $G = u \times B - [u \times b]$ .

Under some specific condition, the value of  $\mathcal{E}$  is shown as following, i.e.,

$$\mathcal{E} = \alpha [B] - \beta \text{curl} [B] + \dots, \dots\dots\dots(7)$$

where,

$$\alpha = -(1/3) \int_0^\infty [u(t) \text{curl} u(t)] dt, \text{ and } \beta = (1/3) \int_0^\infty [u(t) u(t)] dt, \dots\dots\dots(8)$$

One of the way to describe feature of the mean-field induction equation is the term involving  $\alpha$  (that is called as the  $\alpha$  effect).

Following to Knause (1967),  $\alpha \approx +1\Omega$  (or  $-1\Omega$ ) is the mean angular velocity of the Sun. The sign of  $\alpha$  depends on helicity of the flow in the solar convection.

Stix(1976) has shown the meridional cross sections for contours of constant toroidal field strength and poloidal lines of force (cf. Figure 1). The arrows are indicating strength and sign of polar field. An illustration is given in an adjusted time scale for 11 years for each half-cycle.

Theoretical butterfly diagram (contours of constant toroidal field) in an oscillatory kinematic  $\alpha \Omega$  dynamo is shown by Steenbeck and Krause in 1969 (cf. Figure 2).

The numerical results noted above is obtained under several assumption with some conditions, so that specific patterns could be demonstrated on the bases of the dynamical theory in an approximated forms as introduced by Stix [1].

The author here has to notice that the scientists should have their understanding of the specific pattern in the solar activity at considering the geophysical processes on the planet earth.



#### 4. CHAOTIC DYNAMO

As a dynamic system, the magnetohydrodynamic dynamo is capable of chaotic behaviour. Such can be seen from the numerical integrations mentioned, for example, by Stix [1].

A simplified expression of the model can be written as follow, i.e.,

$$(\partial / \partial t)A = 2DB - A, \dots\dots\dots(9)$$

$$(\partial / \partial t)B = iA - (1/2)i\Omega A' \cdot B, \dots\dots\dots(10)$$

$$(\partial / \partial t)\Omega = -iAB \cdot \nabla \Omega \dots\dots\dots(11)$$

where,  $A'$  is complex conjugate of  $A$ .

System (9) to (11) is a complex generalization of a system first studied by Lorenz in 1963 as a model of turbulent convection. The system in this work likes to the Lornz system. It has chaotic solutions but also has solutions which are periodic in time.

#### 5. DISCUSSIONS AND CONCLUSIONS

A theoretical background is introduced in a form of shortened expression. This might be helpful for realizing the monitored solar activity or the 11 year cycle of the sun spots number index. This work might be well related to the various geophysical processes found on the planet earth. Nevertheless, it is yet necessary to consider how complicated processes appear in the earth as well as in the sun.

It should be aware of an advanced research to be promoted even at present for our dynamical understanding of the sun as well as the planet earth where we are living.

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- [3] Stix, M. 1989 The Sun-an introduction, Astronomy and Astrophysics Library, Springer-Verlag, 390p.

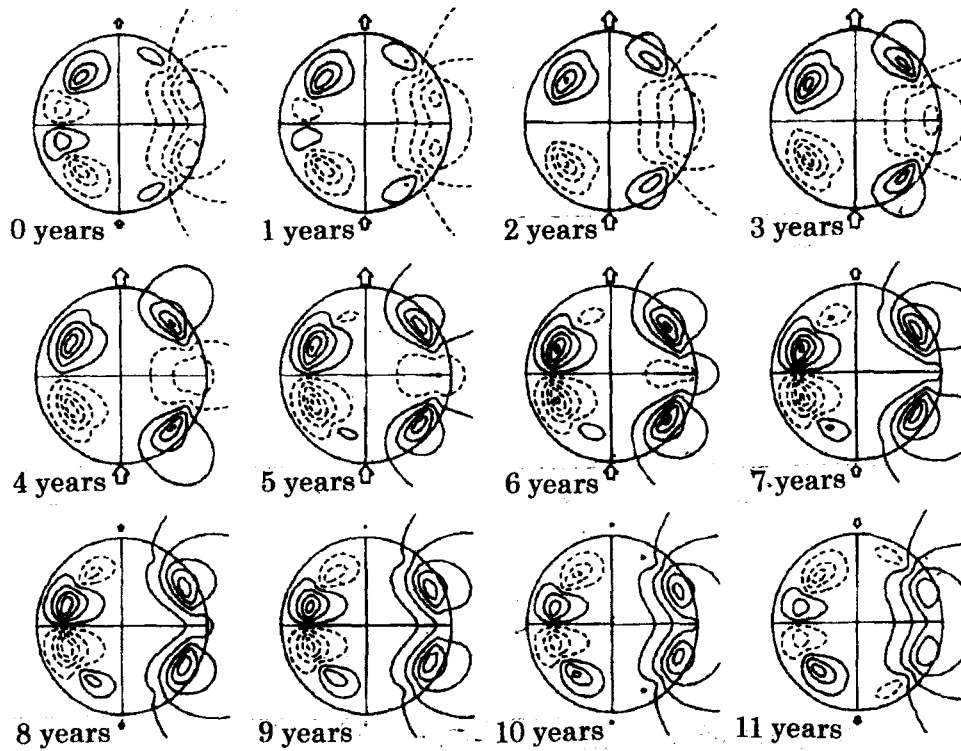


Figure 1 Oscillatory kinematic  $\alpha \Omega$  dynamo model  
In each illustration in every year, the meridional cross section is shown as (1)  
(1) on the right: contours of constant toroidal field strength,  
(2) on the left: contours of constant poloidal lines of force.  
(3) arrows indicate strength and sign of the polar field,  
(4) time scale is adjusted to 11 years for each half-cycle.  
(5) refer to Stix (1976)

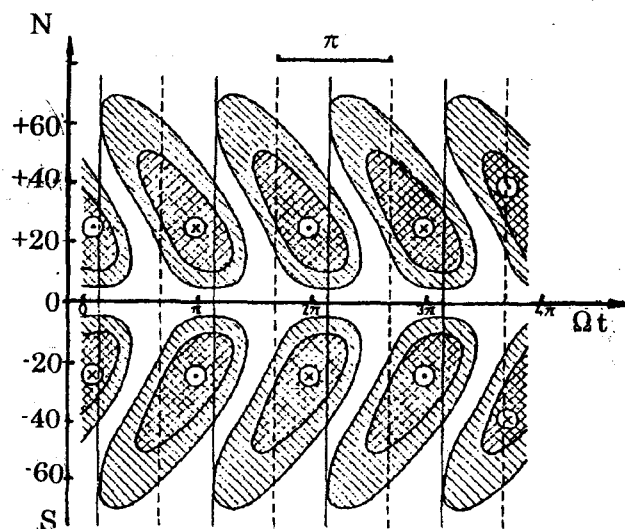


Figure 2 Theoretical butterfly diagram (contours of constant toroidal field) in an oscillatory kinematic  $\alpha \Omega$  dynamo model (cf. Steenbeck and Krause, 1969).

# THE 11 YEAR SOLAR CYCLE AND SEA SURFACE TEMPERATURE

Shigehisa Nakamura  
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**Abstract**—This is a brief note to the monitored solar cycle in relation to the sea surface temperature at a station in the ocean. First of all, a short note on the monitored solar cycle as a part of “Astronomy”. One of the most classic interests for the scientists is “global magnetism” of the sun just like the main magnetic field of the earth. A note is given to a part of the observed result of sea surface temperature trend fit well to sun spot number index trend introduced in 2009 by the Azores Science group.

## 1. INTRODUCTION

This is a brief note to the monitored solar cycle in relation to the sea surface temperature at a station in the ocean. First of all, the author introduces a short note on the monitored solar cycle as a part of astronomy. It must be familiar to the scientists what the author notes as a briefing of the astronomical knowledge especially for realizing what should be considered about the relation between the sea surface temperature variations at Azores in the Atlantic Ocean and the sun spot number index variations during the time period of 1960 to 2007. A notice is given whether the fitting trends of the two factors could be possible to extend for the following several ten years.

## 2. SOLAR CYCLE

A convenient index of the solar cycle is the sun spot relative number, for example, Chapman ever written in his publication in 1964 [1]. As for the two types of “sun spot models”, the first one is an empirical one. The second one is the magnetohydrostatic model. These models has been developed, for example, by Stix, 1989[2].

A part of solar cycle variation of sun spots is introduced in a diagram, for example, as found in Figure 1. So-called solar cycle has been well known by the geophysical scientists though its dynamical mechanism has been extensively studied in the fields related to astronomy.

This 11 year cycle was found first by Schwabe in 1844. Hale had the first scientist of the magnetic field in sun spots in 1908. Hale had observed them by 1923 and formulated his polarity rules on his bases of three consecutive cycles. That is to say, Hale’s rules are so as that:

- (1) the magnetic orientation of leader and follower spots in bipolar groups remains the same in each hemisphere over each 11-year cycle,
- (2) the bipolar groups in the two hemispheres have opposite magnetic orientation,
- (3) the magnetic orientation of bipolar groups reverses from one cycle to the next.

Chapman[1] and Stix[2] had noted in his publication to a more detailed terms. For example, trends of the solar cycle variation of sun spots, prominences, and faculae. The numbers of northern and southern polar faculae are drawn with a sign in order to indicate the alternating magnetic polarity (which was published by Sheeley in 1964). Stix[1] had given the signs of plus or minus mark magnetic reversals at the poles in 1974.

### 3. BUTTTERFLY DIAGRAM

Another important result is known as butterfly diagram introduced by Maunder in 1922. The systematic behaviour of bipolar sun spot groups is readily understood in terms of a subsurface mean toroidal magnetic field, which is a field where lines of force are circles around the solar axis [1, 2].

In addition to the mean toroidal field there is a mean poloidal magnetic field. Cowling (1934) stated first the line-of-sight component of the magnetic vector field  $B$ . The mean field electrodynamics has been developed since 1955 by Parker and his followers.

### 4. SEA SURFACE TEMPERATURE

In 2007, the Azores Scientific Group showed that the observed sea surface temperature during the time period of 1960 to 2007 has shown a significant trend to fit the solar cycle variation of sun spots for four consecutive solar cycles. Nevertheless, it is hard to accept what has introduced by the Azores Group for helping to understand any global trend of the sea surface temperature on the planet earth. The scientists for dynamics of the ocean and atmosphere have found already any dynamical processes of the geophysical fluid motions are not so simple to see on a basis of a limited data observed on the earth surface. The Azores Group had a lucky position of their station for obtaining their interesting finding.

### 5. DISCUSSIONS AND CONCLUSIONS

The author here has to note whether the Azores Scientific Group could show a same trend for their extensive observation of the sea surface temperature in relation to solar spots for about several ten years trends of the two physical factors.

The ocean scientists have learned that the sea surface thermal pattern on the earth is not so simple that it is hard to take it easy to relate the sea surface temperature variations at Azores in the Atlantic Ocean to the sun spots number variations as an index of the solar activity.

The ocean water has a complicated system of the ocean water motion between the earth crust surface and the atmospheric layer under an affect of the solar radiation.

So that, a global understanding of the ocean thermal transferring system should be taken into consideration at discussing on the sea surface temperature variations for obtaining a more reasonable understanding in a physical scope.

Finally, it is expected that a more advanced research should be promoted for a dynamical understanding of the various processes appear on the earth under the effect of the solar radiation.

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- [1] Chapman, S. 1964 Solar plasma, geomagnetism, and aurora, Gordon and Breach, New-York, 141p.
- [2] Stix, M. 1989 The Sun-An introduction, Springer-Verlag, 390p.

### Relative Sun Spots Number Index

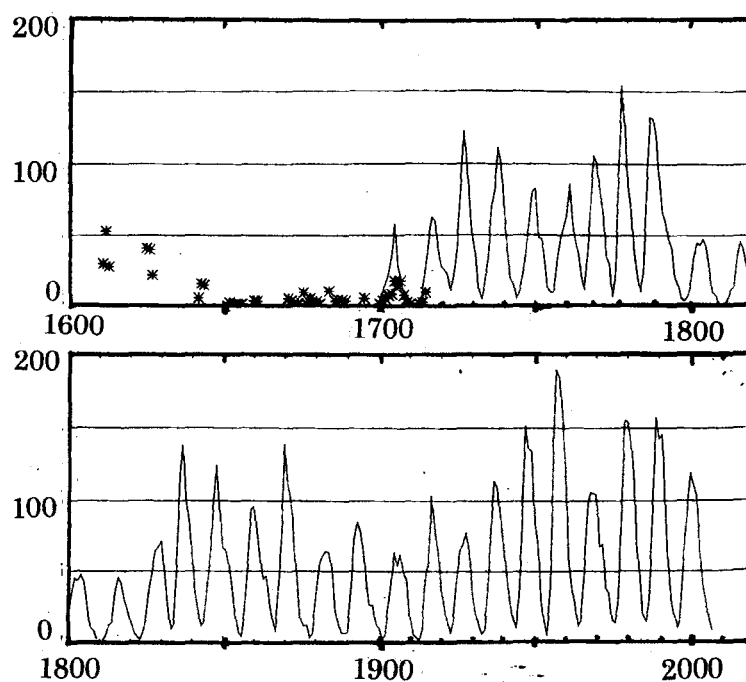


Figure 1 Solar cycle variation of sun spots

### Latitude

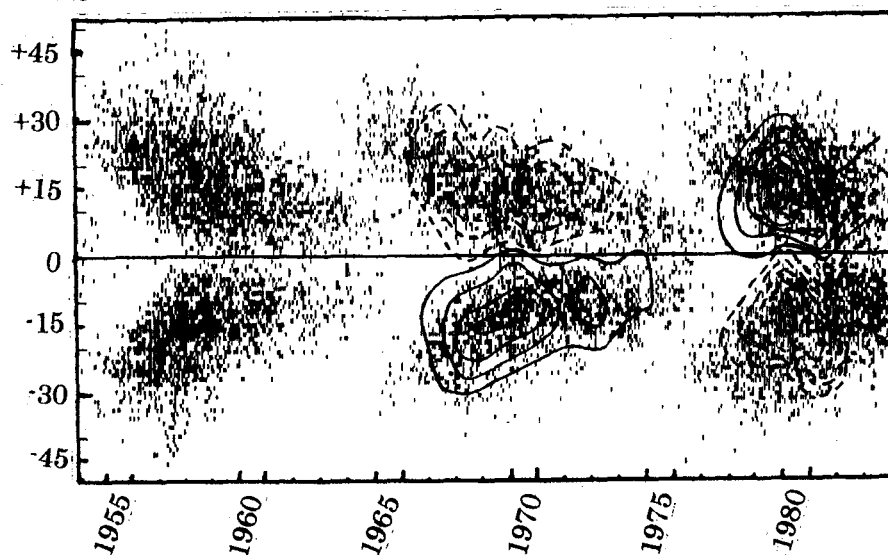


Figure 2 Butterfly diagram from Mt. Wilson Observatory  
(courtesy R. Howard, National Solar Observatory)

Note: (1) contours of radial mean field

(from Mt. Wilson and Stanford magnetograms)

(2) each vertical bar marks a sun spot

(3) the contours are (a) for solid positive  $27 \mu T$ ,  $54 \mu T$ , ...,

(b) for dashed negative  $-27 \mu T$ ,  $-54 \mu T$ , ....

## **2. THERMAL DOME**

- (1) Thermal Dome in the Atmospheric Surface Layer**
- (2) Thermal Dome on the Ocean Surface**
- (3) Thermal Dome above the Atmosphere**

# THERMAL DOME IN THE ATMOSPHERIC SURFACE LAYER

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**Abstract**— In order to see specific pattern of the monitored thermal dome formed on the atmospheric layer on the earth, a model is introduced for helping to obtain the pattern of the thermal dome in a form of mathematical expression. The solution is constructed by the interesting factors at determining the shape of the thermal dome envelope. Some note is given to see about the actual pattern found.

## 1. INTRODUCTION

In order to see specific pattern of the thermal dome found in the atmospheric layer on the earth. For a convenience, a formulation is introduced for a model of the interested thermal dome. A solution is obtained as a result of reduction of the formulated equation under some given conditions. A mathematical technique is convenient at reducing the equation in order to obtain the solution. It can be seen that the several factors are constructing the form of the solution. These factors may specify the thermal dome envelope. In the actual case of the thermal dome, the solution can be taken as a simulated model approximately. Then, the author would give his note for relation between the fact and the model.

## 2. MODEL OF THERMAL DOME

In order to describe a thermal dome in the atmospheric layer on the earth surface, a model is assumed to be constructed by a formulation of fluid dynamics of atmosphere in the troposphere defined as that between the tropopause and the earth surface.

In the troposphere, vertical distribution of the atmospheric temperature can be described as follows,

$$T(z) = \Gamma z + T_0, \dots\dots\dots(1)$$

Where,  $T(z)$  is an equivalent potential temperature at the height  $z$  above the earth surface, and  $T_0 = T(z = 0)$ . In the actual atmospheric layer,  $\Gamma = 4\text{degreeC per } 1000\text{m}$  (for example, Kimura, [1]).

As for a case of heat island in an urban area, Kimura had given a brief note with his model for application to the case in the city area of Tokyo [2].

In this work, a thermal dome is a model. For the author's convenience, a local small area on the earth surface is assumed as a heat source which is the trigger of a thermal dome.

Usually, motion of an air particle in the interested atmospheric layer, can be taken as a resultant of a motion in the mean field and a field of disturbances. It is easily understood what form is the simple expression of the static state of the atmospheric layer. So that, it should be concentrated to the author's interest how to formulate the field of the disturbances which could contributive to see a thermal dome formation. One of the



mathematical techniques is to take one of the disturbances as a simplified perturbation. Then, it is simplified the problem in this work to ease a formulation.

### 3. FORMULATION

Now, a cylindrical coordinate system with the vertical axis ( $z$ ), a horizontal radial axis ( $x$ ) and circular angle axis ( $\phi$ ) referring to the radial axis is introduced as the reference.

Assume a heat source located at the origin of the cylindrical coordinate system, the thermal dome modeling can be formulated to make ease in a mathematical reduction at obtaining a solution. When the angular motion of the interested air particle in the layer is negligible or not exist, formulated description can be seen in a more simple form. In this case, the expression form can be simplified as follows, i.e.,

$$[u(x, z, \phi; t), w(x, z, \phi; t), p(x, z, \phi; t)] = [u(x, z; t), w(x, z; t), p(x, z; t)]$$

With the consideration noted above, the set of the equation for the interesting model can be written in a non-dimensional form as that shown as follow, i.e.,

$$(\partial u / \partial t) + u(\partial u / \partial x) + w(\partial u / \partial z) = -(1/\rho)(\partial p / \partial x) + \nabla(\nu \nabla u), \dots\dots\dots(2)$$

$$(\partial w / \partial t) + u(\partial w / \partial x) + w(\partial w / \partial z) = -(1/\rho)(\partial p / \partial z) + \alpha g T + \nabla(\nu \nabla w), \dots\dots\dots(3)$$

where the velocity field ( $u, w$ ), the temperature field  $T$  and pressure field  $p$  at the location at ( $x, z$ ) for the density field  $\rho$  in a layer of isotropic air particles with a viscosity constant  $\nu$  in brief, though the exact expression of  $\kappa$  in a general form must be a tensor.

As for the equation of potential temperature, it can be written as

$$(\partial T / \partial t) + u(\partial T / \partial x) + w(\partial T / \partial z) + w \Gamma = \nabla(\kappa \nabla T), \dots\dots\dots(4)$$

where the notation  $\kappa$  for diffusion coefficient.

The above equations (2), (3) and (4) form a simultaneous equation system which looks quite similar form for the case of two dimensional problem on heat island or cool island [2]. In this work, a set of approximated linear equations is considered for obtain an asymptotic solution in the atmospheric layer on the earth surface.

The boundary conditions are as follow for convenience, i.e.,

$$u = 0, w = 0, \text{ and } T = T_0 \cos kx, \text{ for } z = 0, \dots\dots\dots(5)$$

and

$$u \rightarrow 0, w \rightarrow 0, \text{ and } T \rightarrow 0, \text{ for } z \rightarrow \infty \dots\dots\dots(6)$$

After rewriting introducing several parameters and applying the Cauchy-Rieman relation to introduce a stream function, the reduced form of the equation is obtained as follows,

$$(\partial^2 T / \partial x^2) + (E_0^2 / Pr)(\partial^6 T / \partial z^6) = 0, \dots\dots\dots(7)$$

where,  $E_0 = \nu^2 / (\alpha g \Gamma L^4)$ , and  $Pr = \nu / \kappa$ . When rewriting the above (6) after introducing that  $(1/Ra) = (E_0^2 / Pr)$  with a consideration of  $z/\delta$ , then, an order estimation of the thermal dome formation in scale must be expected as that evaluated  $\delta^6 = (1/Ra)$ . In the equation of the above (7), time factor is implicit under the specific assumptions and conditions.



#### 4. VERTICAL SECTION OF THERMAL DOME

The solution of the equation (7) can be obtained with an assumption of  $T = \theta(\eta) \cos kx$  for  $\eta = z/\delta$ . Now, the equation is rewritten as

$$(d^6 \theta / d\eta^6) = k^2 \theta \dots\dots\dots(8)$$

Substituting  $\theta = \exp(\sigma \lambda \eta)$  with  $\sigma^6 = k^2$ , then,  $\lambda^6 = 1$ . So that, six eigen values of the equation (8) are expected. The equation (8) have six roots, nevertheless three roots in term of positive real part do not satisfy the boundary condition for  $z \rightarrow 0$ . Then, the solution satisfying the necessary conditions for  $z=0$  can be written as

$$\theta = (1/2) \exp(-\sigma \eta) + (1/\sqrt{3}) \exp(-\sigma \eta/2) \cos[(\sqrt{3}/2) \sigma \eta - (\pi/6)] \dots\dots\dots(9)$$

The author has now obtained a solution for the interested two dimensional problem in a vertical cross section with the vertical axis passing the origin in the coordinates. Obtained solution tells us that a form of the interested thermal dome is determined by the heat source pattern on the earth surface. An assumption makes it possible to describe the heat source pattern by a mathematical function.

#### 5. GOVERNING AREA OF THERMAL PATTERN

The author has introduced the solution (9) for the thermal dome pattern under several assumptions with some restricts of the given conditions.

Now, it is necessary to give a notice about what is essential at modeling the thermal dome as the two dimensional (2D) problem and the three dimensional (3D) problem even though the solution is apparently expressed in the same form after reducing mathematical process for solving the equation (7).

Under the given assumptions and conditions for the thermal dome in this work, the 3D problem in the cylindrical coordinate system is boldly a problem for a thermal disc. With the assumption of no circular thermal gradient or of no circular motion, the solution is written apparently in a same form of the solution as the function of (x, z). Nevertheless, the 2D problem (for example, in the case of a heat island [2])

The solution is for the thermal dome area in the 3D problem. The solution for the 3D model should be essentially different from for the 2D model. It can be expressed as that the solution for the 2D model simply gives a segment of a vertical section of the 3D model. Then, the total thermal energy  $E$  for temperature potential  $T$  concerns to the 3D model should be written as follows when the solution for the 2D segment (thermal energy  $E'$ ) shows the vertical section of the 3D model. Then,

$$E = \oint E' d\phi, \text{ or, } E = \int_0^{2\pi} E' d\phi. \dots\dots\dots(10)$$

#### 6. DISCUSSIONS

The author has a mathematical solution for a thermal dome in the atmospheric layer on the earth surface. This solution suggests a specific structure of the atmospheric convection at the core of the thermal dome in fact. The specific photographs are ever obtained by the

optical camera on board of an air craft. Some of these are the examples of an explosive nuclear energy release [3]. An illustration is given in the photographs in Figure 1. Each of the cases in the figures is a shot at an instance of the transitional process, though each of the photographs shows that the final stage of the energy release supports approximately the model of a thermal dome pattern. In the model, it is referred to consideration in an approximated formulation for a mathematical solution with an infinitely asymptotic solution. The solution is apparently independent of the time factor in this work under the assumptions and the given conditions. This solution could be taken to be an approximated thermal dome pattern.

An application of the model introduced in this work might be well considered for the heat island developed in the urban area seems to be supporting the solution in this work [2]. Adding to the above, a case of continuous volcanic explosions could be realized even though the volcanic processes are not so simple in fact.

A set of approximated linear equations are introduced for the formulation in this work, The solution looks to be supported by the optical monitoring of the thermal dome in the atmospheric layer on the earth boldly. A nonlinear problem with a consideration of time variable must be raised for the next step in order to promote the related research works.

## 7. CONCLUSIONS

The author noted some specific pattern of the thermal dome as a solution in an approximated linear problem in relation to a possible pattern of the thermal dome in the actual atmospheric layer on the earth surface. Some remarks are given for application of the thermal dome model. The next step must be to develop this work in a nonlinear problem to obtain a more strict solution. A numerical computation must be more helpful for realizing what is the thermal structure inside the thermal dome model. A more advanced research is expected for understanding the thermal dome formation process.

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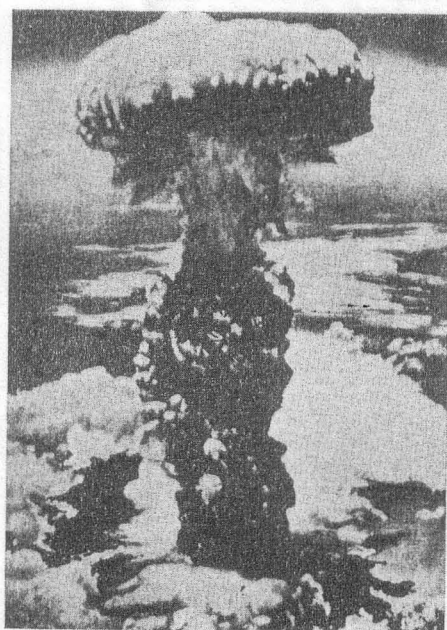


Figure 1 Thermal dome pattern at an explosive nuclear energy release on 9 August 1945 at Nagasaki [3],  
(by the courtesy of USAF ).



# THERMAL DOME ON THE OCEAN SURFACE

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**Abstract-** This is a note about a case of thermal dome formed after an explosive energy release in the ocean surface layer on the earth. A theoretical model is introduced for realizing the pattern of the thermal dome in a mathematical expression. The solution is constructed by the main factors related to the physical process of the dome formation. Some notices are given to see what about the actual pattern was monitored.

## 1. INTRODUCTION

In order to realize specific pattern of the thermal dome formed in the atmospheric layer on the ocean surface layer covering a coral lagoon on the earth crust. For a convenience, a linear formulation is introduced under an assumption of no circular motion around a thermal source point. A solution is expressed by several physical factors which help us to see what specific thermal dome pattern is. Actually the process of the thermal dome must be a kind of non-linear one, nevertheless an approximated process could be obtained by solving a linear problem. Then, it could be given some remarks for the following works to an advanced research and applications.

## 2. SAMPLE CASE OF THERMAL DOME

In order to demonstrate a thermal dome in the atmospheric layer above the ocean surface layer which covering a coral lagoon on the earth crust, a model is assumed to be constructed by a fluid dynamics of atmosphere in the troposphere between the tropopause and the earth surface.

In the troposphere, vertical distribution of the atmospheric temperature can be described as

$$T(z) = \Gamma z + T_0, \dots\dots\dots(1)$$

Where,  $T(z)$  is an equivalent potential temperature at the height above the sea surface, and  $T_0 = T(z=0)$ . In the actual atmospheric layer, it can be expressed as  $\Gamma=4^\circ\text{C}$  per 1000m (for example, Kimura [1])

As for a case of heat island in an urban area, Kimura had written his brief note in his publication [2]. In this case, a local small area on the earth surface is assumed as a heat source (positive for heating or negative for cooling) of the thermal dome formed on land. There has no land surface condition considered except the atmospheric condition.

As for the ocean surface layer, an assumption is as that the uniform thermal layer of the sea water about 200m or less. Under the sea surface, a spread of coral lagoons is considered to over the earth crust.

A heat source is assumed to be a point source just under the ocean surface.

As for the mean field of winds above the sea surface, this field is excluded out of the

resultant field of the winds in order to distinguish the variations of the wind field which is generated and affected by an energy release at the heat source located at the origin of a co-ordinates system. When the heat source is assumed to be located at a point, a convenient co-ordinates system must be in a semi-spherical field on the sea surface, and a cross section of the interested thermal dome might be expected as a semi-circular space above the sea surface.

### 3. FORMULATION

Now, assuming a semi-spherical co-ordinates system  $(r, \theta, \phi; t)$ , each of the velocity components in the interested field can be expressed by gradient of  $r, \theta$ , and  $\phi$ , respectively. Considering the axis of  $r$  is taken to be vertical positive and the plane formed by the axes  $\theta$  and  $\phi$  fit on the ocean surface with the origin 0, then, the velocity field can be expressed as follow if the angular velocity is negligible for an assumption of only rotational motion but any motion across the circular shell of the semi-sphere. That is,

$$[u(r, \theta, \phi; t), v(r, \theta, \phi; t), w(r, \theta, \phi; t)] = [u(r, \theta; t), v(r, \theta; t), w(r, \theta, t)] \dots (2)$$

when zero velocity for the radial component of  $\phi$ .

Then, equation of motion for the interested process is written as follow for the cross section:

$$(\partial u / \partial t) + u(\partial u / \partial r) + v(1/r)(\partial u / \partial \theta) = -(1/\rho)(\partial p / \partial r) + \alpha g T + \nabla(v \nabla u) \dots (3)$$

and,

$$(\partial v / \partial t) + u(\partial v / \partial r) + v(1/r)(\partial v / \partial \theta) = -(1/\rho)(\partial p / \partial \theta) + \nabla(v \nabla v) \dots (4)$$

As for the equation of potential temperature in the atmospheric layer,

$$(\partial T / \partial t) + u(\partial T / \partial r) + v(1/r)(\partial T / \partial \theta) + v \Gamma = \nabla(\kappa \nabla T) \dots (5)$$

When the thermal energy radiation is radiated at the point source located at the origin, the thermal disturbances out of the heat source is essentially propagate radial.

### 4. PATTERN OF THERMAL DOME

In a case of thermal dome produced by the enormous amount of thermal energy release as a result of a nuclear reaction process, it can be expected a radial propagation of the front formed by the thermal energy radiation quickly before any thermal convective motion is induced in the atmospheric zone. A spherical shock front might be formed even if any human body was on the paths of the thermal radiation.

When the energy was radiated after a nuclear reaction, the first radiation should be propagated in the speed of the electromagnetic waves (that is to say, instantaneously). Then, thermal energy must be followed to that after completing the energy exchange process between the radiation beams out of the source and the atomic or molecular particles on the paths of the radiations of the electromagnetic power out of the source. This might be called "Fire Ball". With the time elapse, the fire ball grew quickly in a short time. Inside of the fire ball, there might had been generated the complicated motions of the atmosphere trapped by the fire ball. The thermal energy in the fire ball might surely

be diffused out across the surface of the fire ball.

The ocean water might be forced to be activated by the nuclear effect though the thermal effect to the ocean surface water was easily happened to generate an evaporated water mass pinnacle at the origin. The water vapor must have formed a dense cloudy column to make a mushroom shape shell just as the thermal front of the dome. The growth of the speed was so quick that there must surely be generated a spherical shock front because this speed is beyond the propagation speed of the electromagnetic waves induced by the nuclear reaction. One of the examples is shown in Figure 1. To the details, it must be seen in the other publications appeared already in the past [3].

## 5. EXPLOSIVE THERMAL ENERGY RELEASE

In Figure 1, a case of the explosive thermal energy releases is introduced. There might be any cases of the other similar thermal processes.

The author would here give a note to several patterns of the energy release.

- (1) One of the most primitive examples is to make a fire by burning of wood tips or of charcoal carbon tips.
- (2) Fossil fuels are effective in the history of the human activity.
- (3) Dynamite is one of the typical materials as an explosive thermal energy release must be effective in practical purpose for public works. The dynamite was used for battle in the past.
- (4) Nuclear reaction has been utilized for the electric power supply for the public works and citizen services under a well-controlled power release system. Nevertheless, the nuclear reaction (atomic fissures and/or fusions) was used in the world war in order to assure that this was effective to make an explosive thermal energy release as was widely known.
- (5) Primitive nuclear reaction can be make an effective explosive thermal energy release after a trigger strong radiation beam to activate the all of the constituents in the atmosphere, in the waters and on the land surface. The activated materials are changed to be another form of forced radio-active materials which consist in any form of ashes produced at the nuclear reaction by the explosive energy release.
- (6) The activated ashes were transferred into the atmospheric layer after induced convective winds to diffuse out around the surrounding areas.
- (7) As for the case introduced in Figure 1, the ocean water and coral pieces are activated to be the contents of the strong radioactive isotopes. The accuracy of the trigger at each nuclear reactor must be caused to form a crown cap as a set of the main three sheets. The reflected radiations and shock front must be effective to form the minor set of the caps under the main caps set. The shock front in form of a fringe of the cloud on the land surface can be seen.
- (8) The first step was the radioactive isotopes production in advance of the shock front in the atmospheric layer as a thermal dome.
- (9) The explosive thermal energy release was the second step in the case of the nuclear reaction in the case of Figure 1.

To the details, it could be found what was seen at that time in the other publications.

## 6. CONCLUSIONS

The author has had a chance to see a process of a thermal dome after an energy release at a point source. Especially, the thermal energy is generated by a nuclear energy release might cause to form a shock wave as a front of the thermal dome in a form of a fire ball. The author could introduce in this work one of the examples out of the photographs of a

thermal dome formed after a nuclear energy release on the ocean surface layer. This is a key to promote an advanced research successively.

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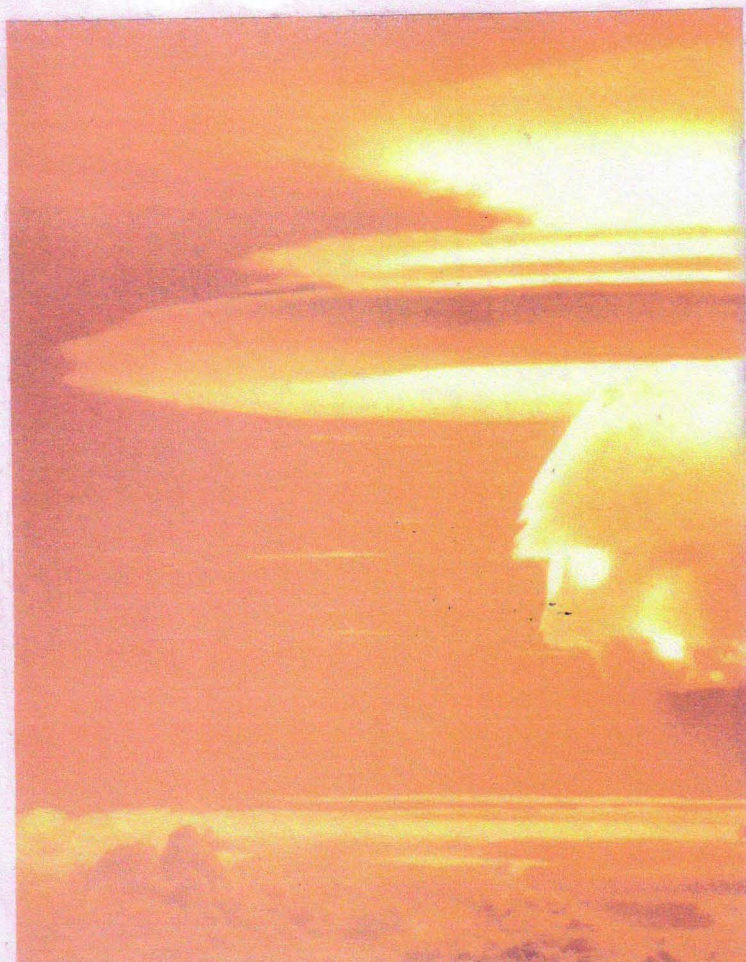


Figure 1 Thermal dome pattern at an explosive nuclear energy release on 1 March 1954 at Bikini Lagoon in the Northwestern Pacific. (by the courtesy of USAF)



# THERMAL DOME ABOVE THE ATMOSPHERE

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**Abstract-** This work concerns to a thermal dome as an iridescent sphere appeared above the atmosphere. The author is a modeling for realize what is a possible process of iridescent sphere above the atmosphere in a physical scope. One of the iridescent spheres in the photographic illustration must be caused by a explosive thermal energy release. A simple formulation for the thermal dome may be effective for understanding the process of the thermal dome above the atmosphere. The author would introduce a key to see the physical process of this thermal dome formation.

## 1. INTRODUCTION

In this work, a process is noted by a model for a thermal dome as an iridescent sphere appeared above the atmosphere in a scope of fluid dynamics. By this time, the author has had monitored the thermal patterns on the ocean surface. His interest is also in the physical process of a thermal dome above the atmosphere. One of the keys must be obtained by introducing a dynamical model. In order to realize this process the author introduced some note in relation to a similar process ever seen on the earth surface.

## 2. DATA SOURCE

One example of the iridescent spheres appeared above the atmosphere off Scandinavia and northern China in 1988 [1]. The data is found in a form of photographic illustration. That is, Reed [1] introduced one of the typical illustrations of the iridescent spheres. This illustration was one example provided by Danny Stillman. In this work, simply the author would focus his interest to introducing a physical model of the thermal dome.

## 3. ATMOSPHERIC LAYER

The interested atmospheric layer in this work must be between tropopause and earth surface. This layer is called as troposphere. In the troposphere, atmospheric convection is taken to be constructed to be a conservative system. In the troposphere, vertical distribution of the atmospheric temperature can be described as

$$T(z) = \Gamma z + T_0, \dots\dots\dots(1)$$

where,  $T(z)$  is an equivalent potential temperature at the height  $z$  above the earth surface, and  $T_0 = T(z=0)$ . In the actual atmospheric layer,  $\Gamma = 4^\circ\text{C}$  per 1000m (for example, Kimura, [2]).



## 4. FORMULATION

In the scope of hydrodynamics, a model is introduced in a form of mathematical formulation. Generally, the model should be for three dimensional in process. Essentially, the equation of motion introduced is nonlinear, though a linealized approximation in the equation could be considered with a fairly good approximation. In this case, the equation for the potential temperature should be also introduced.

## 5. CONDITIONS

In the model, boundary conditions must be considered for  $T$  on the earth surface and the tropopause. Mean field of the winds is excluded so that the disturbances can be obtained an approximated solution solving the linealized equation. Nevertheless, a case of a thermal sphere above the atmosphere can be taken as free from the boundary conditions, if the thickness of the atmospheric layer is large enough comparing to the scale of the thermal dome in interest.

Several cases must be considered at solving the equation to see the process. That is,

- (1) Fireworks using a gunpowder in a classic manner
  - (a) Shoot up vertically in order to get the capsule up to the aimed altitude,
  - (b) The trigger let the capsule to fire at no vertical motion where the capsule in height of the aimed altitude successfully.
- (2) Environment control by using dynamite
  - (a) Set up the position of the firing operation in the schedule,
  - (b) Follow the land-cruisers, shovels, and scrapers
  - (c) Pass a roll over for flatten the ground surface or the related operations.
- (3) Operate to fire or crush in the certain position in the atmospheric layer
  - (a) Shoot up a capsule containing a gunpowder, or trinitrotoluene, or nuclear reactor,
  - (b) Control to work the trigger for firing or for the purpose in plan.

To the details, it is recommended to refer to the other related guidelines.

## 6. DISCUSSIONS

For a convenience, the author here introduce some discussions about the illustration as shown in Figure 1 in order to realize the process of a thermal dome formation. Looking at the pattern of the dome, it can be seen that a point source moving in the atmospheric layer at the trigger for firing in operation. A line of light in the dome area seems to be suggesting the orbit of the capsule on a ballistic orbit. The author has no data to the details so that it seems too hard to tell a certain deterministic notice. Nevertheless, the past examples of the explosive thermal energy release are taken to show us an essentially common process is found in the illustration. What is essential is axis of the acceleration.

Reed [1] noted that the thermal dome is expanded very rapidly, at around 3km/s, with the centers remaining quite transparent. The author has no idea to give any comment for the speed of the dome expanding. Although, it is sure that this speed is about one third of the critical velocity on the ballistic orbit, and is also approximately one third of the speed of an existing satellite in the steady polar orbital motion.

As far as the author concerns, he thinks that it is hard to give any deterministic notice under this condition without any detail of the scientific data in need.

## 7. CONCLUSIONS

A model of a thermal dome above the atmosphere is introduced in order to what process was in the illustration including an ilidescent sphere. With consideration of the related factors and conditions, the author may take it as that the illustration is showing a thermal dome formed around the axis of the acceleration along the ballistic orbit.

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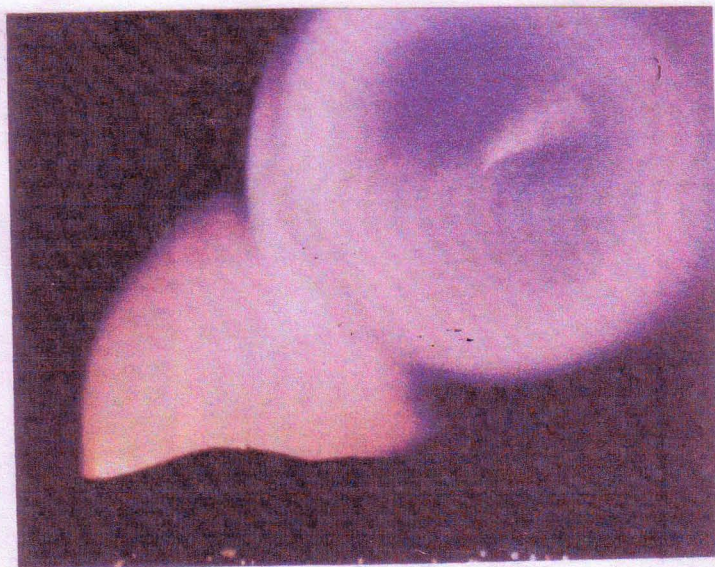


Figure 1 One example of the iridescent spheres appeared above the atmosphere  
off Scandinavia  
(by the courtesy of T. C. Reed and Danny Stillman )

### 3. AURORA

#### (1) Aurora Oval and Solar Winds

#### (2) Hazardous Aurora over the Ocean



# AURORA OVAL AND SOLAR WINDS

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**Abstract** This work concerns to a problem on satellite monitoring of the aurora oval on the earth in relation to solar winds. First, a brief review is introduced for helping of our understanding of what relation is between the earth and the solar winds. A history of dawn in geomagnetism is also noted briefly. The advance of research works helped to get a mosaic illustration of the aurora which was monitored by an aurora scanner mounted on a polar orbital satellite.

## 1. INTRODUCTION

This work concerns on satellite monitoring of the aurora oval on the earth in relation to solar winds. First of all, a brief review is given for help of our understanding of what is seen in the solar-earth system. The earth is approximately taken as a dipole-magnet in order to realize the earth's main field. The variation of magnetic field on the earth is consisted mainly by the effect of ionized particles flowing in the atmosphere with some minor effects by the ocean tides and the solid earth crusts. Nevertheless, the mechanism of the aurora has to be realized after consideration of the solar winds which distort to form a shade of the magnetopause in the solar-earth planetary system. The shade front to the sun was found at a distant of about eight times of the earth's radius in the early age (cf. monitoring by Explorer-12). A brief note is introduced about the history of dawn in geomagnetism is also noted. The advance of the research works by the scientists helped to obtain the first mosaic illustration of the aurora oval boreares after the satellite monitoring by the aurora scanner mounted by a satellite on a polar orbital satellite.

## 2. DAWN OF GEOMAGNETISM

A primitive model of the earth had been taken as a planet of a simple dipole magnetic model. In these years, it has been understood that the magnetic field of the earth is not so simple referring to the data compiled by the various instruments and to the theoretical models developed for the model of the earth's magnetic field [1]. Main field is taken a magnet which is essentially same to a small magnet for students in primary educational course.

Christian Birkeland in Norway visited Henri Poincare in Paris first for learning Maxwell's theory of electromagnetism. After that, Birkeland learned electromagnetic wave under H.Herz. In 1895, many works had been done by the scientists about properties of X-ray. Then, Birkeland started his research and survey on the aurora boreares. His first expedition was in 1897. He found that the aurora appears higher position than any cloud in the atmospheric layer in his second expedition (1899-1900). Birkeland introduced a model of solar-originated electrons incidence in order to illustrate the geomagnetic variations found by his expedition and by the project of the IPY (International Polar Year). Birkeland published his contributions in "Norwegian Polaris Expedition". This might be the theoretical contribution of aurora in our understanding of the modern works presented by the scientists even in the 2010 age.

### 3. MODERN RESEARCHES

As far as we concern, the magnetic field of the earth had been understood as a dipole model in the primitive pattern. Nevertheless, it has been developed an advanced research for a more reasonable electromagnetic hydrodynamics in order to have a proper modeling under our renewal of modern knowledge of the earth's internal structure. This is the key to introduced the recent dynamo-theory for the earth's main field describing by the poloidal and toroidal modes.

In addition, the solar winds as an uniform plasma flow may force to form a shell of the magnetopause and to distort the magnetic field of the planet earth (cf. Figure 1).

On the other hand, several observation projects were in schedule as the International Polar Year (in brief, IPY-1 and IPY-2) and as the International Geophysical Year (IGY).

Electromagnetic understanding of the solar-earth system has been advanced to obtain a modeling image of a giant magneto-hydrodynamic dynamo. By this time, the scientists had the research projects of IPY as the IPY-1 (1882-1883) and the IPY-2 (1932-1933). Chapman and Bartels (1940) have introduced a model of a quiet day variation (Sq) in the geomagnetic variations. The model supports the harmonic analyses in Kyoto University for the IPY-1 data of the stations settled on the earth. Hirono had introduced his dynamo-theory in 1957 after Elsasser's hydromagnetic-dynamo theory [2]. The advanced project as IGY (1957-1958) was extended to start the Antarctic Research Program in a long term scale. Research on ionosphere had promoted during survey of the radio wave propagation to find E, F1 and F2-layers in a scale of the earth after O.Heaviside's notice of a conductive layer which could form a wave guide of electromagnetic waves between the ocean surface and the interested conductive layer. As for the aurora, Birkeland published Norwegian Aurora Polaris Expedition (1913). Here, the author feels it necessary to note that Birkeland was acquainted to Aikitu Tanakadate, Torahiko Terada, Hantaro Nagaoka in Japan. Significant contributions were by, for example, Alfven in 1950 and Stermar in 1955. A more advanced publication must be that written by Chapman in 1964 [3].

### 4. RADIATION IN UPPER ATMOSPHERE

Van Allen (Iowa State University) had some observations of the radiations in the upper atmosphere (1952-1953) by using several rockets. Then, he had found that some strong radiations were concentrated just in the aurora oval zone. After this finding, he had a chance to obtain some records by using his Geiger-counter for radiations. It was the first time of that the radiation belts were found by the sensors mounted on some artificial satellites. Some works are for the radiation belt enhancements appeared in the references (cf. [4] and [5]).

Later, it was clarified that the radiation belts (inside and outside) had no relation to the possible electron beam to induce the aurora. To the details, it should be referred to the other publications. Simply, the author notes that the belt denoted E in Figure 2. The magnetopause facing the sun (day light side) is in a shape of conical form and the magnetopause in the shadow zone (dark night side) is in a form of a tail.

The inside zone in the tail of the magnetopause is taken to be filled by plasma. A part of the plasma in the tail near the earth is in a form of plasma sheet on the equatorial plane. The extension of the plasma sheet separated in to two part (northern and southern) to contact on the earth surface. So that, it should be noticed that the solar winds in a form of an uniform plasma flow could hit the consisting atoms and molecules just outside of the plasma sheet to hit and activate the upper atmosphere which could be taken us as a kind of the visible aurora boreales. The aurora oval on the earth might be found in the fresh reports in these years, for example, Manda and Papistoshvili [6].

## 5. SATELLITE MONITORING

Akasofu (1981) has given a digestive illustration for his review on the research of the aurora. Loomis had completed his map of the aurora oval boreares one hundred years before the IGY (1957-1958). Optical aspect of the aurora had clarified that the aurora was appeared when atoms and molecules in the atmosphere were excited stage under some specific condition. With the above noticed contributions, problem raised was to see the aurora oval by using an aurora scanner mounted on a artificial satellite in a polar orbital motion. One of the most typical cases was the aurora oval monitored by the satellite ICIS-2. The result of a monochromatic mosaic illustration of the aurora boreares was obtained by C.D.Anger. C.D.Anger at Calgary University in Canada had used his phototube applied system of an electric circuit for monitoring aurora oval in the northern hemisphere.

A geomagnetic flux field in the aurora oval zone is schematically introduced as shown in Figure 3. Since then, it is aimed to continue satellite monitoring of aurora boreares (which was presented at Kyoto in 1973). The polar orbital motion of the satellite had given aurora australis too (for example, National Polar Research Institute, Japan).

## 6. DISCUSSIONS AND CONCLUSIONS

This satellite monitoring of the aurora is surely be effective to see the more detailed structure of the aurora. As the results of the research on the aurora, it is confirmed that the ionized particles of the solar winds might surely be a trigger to induce an activated energy level of the gasses in the atmosphere (especially, the atoms and molecules of oxygen and nitrogen). This energy transfer makes it possible to form the visible aurora in the aurora oval zone in a high speed to ionize by transferring to the atoms and the molecules of oxygen and nitrogen. At this stage, the author has to notice that it is necessary to continue the successive satellite monitoring of the aurora for our advanced research.

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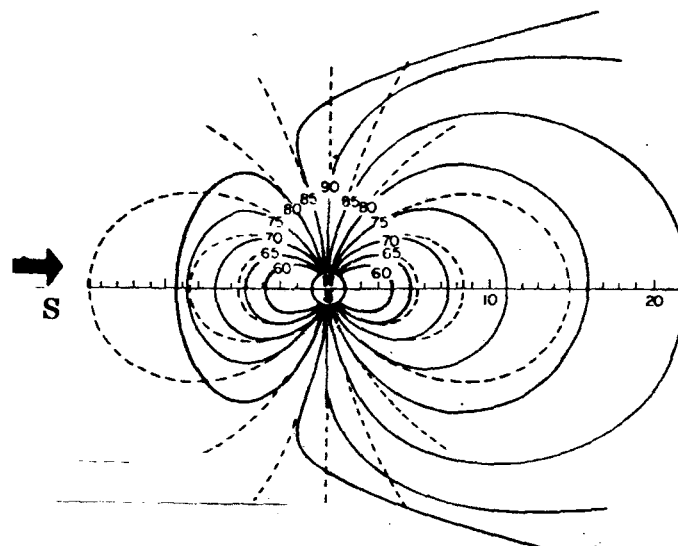


Figure 1 Magnetic field of dipole-Earth distorted by solar wind.  
(1) dot-line for dipole-Earth field, (2) full-line for distorted field,  
(3) arrow for solar wind [modified from Akasoh, S.-I., 1975]

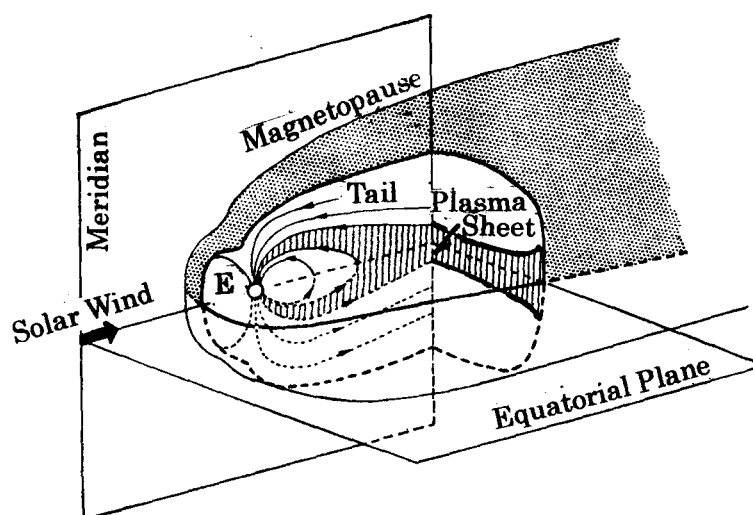


Figure 2 Solar-Earth system.

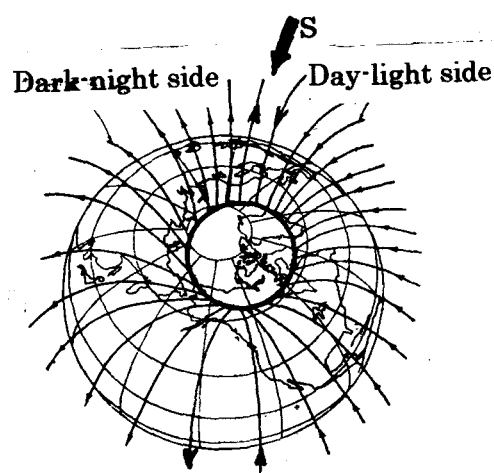


Figure 3 Electric current around "Aurora Oval Boreares"

[by the courtesy of Akasoh, S.-I.]

## HAZARDOUS AURORA OVER THE OCEAN

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**Abstract-** This is a note to aurora in day light side of the earth in relation to the solar plasma flow. The solar plasma flow in a super high speed forces to form a shock front just in front of the magnetopause between the sun and the earth. The intrusion of the electron into the aurora oval zone along the magnetic line releases its energy to form a visible aurora. It is up-dated what process is reasonable to see the coloring of the interested aurora. An additional notice is given to see a non-natural energy release for a dark red sky in the subtropical zone on the ocean.

### 1. INTRODUCTION

This work concerns the aurora which can be seen in the polar area around the north pole of the earth. It is said that some note was left about a red aurora boreales in one of the old records, for example, Nihon-Shoki, edited in 720AD (as noticed Sadami Matsumoto). Birkeland must be the first aurora scientist who published the Norwegian Aurora Polaris Expedition (1902-1903) in 1903 as a part of the International Polar Year (IPY-1, 1882-1883). After IPY-2 (1932-1933), Chapman [1] published "Geomagnetism" in which the contribution of the geomagnetic daily variation  $S_q$  in a solar quiet day. In Kyoto University, Motokazu Hirono had given his theoretical model of geomagnetism with the poloidal and toroidal modes in 1957 for the advanced course of geophysics. Takeshi Nagata promoted the IGY (1957-1958) in the Asian area. In the first Antarctic Research Project in Japan, the leader on-site at the base settled on Antarctic was Eizaburo Nishibori, and Tai'iti Kitamura was the first scientist of aurora Australis. There have been many researches on ionosphere and on aurora as well as on geophysics.

There are many problems on geomagnetism in relation to ionosphere and aurora.

In this work, the author concentrates his interest on the problems on monitoring aurora in day light side of the earth in relation to the solar plasma flow. This solar plasma flow was ever named as solar wind.

Specific feature of the aurora found in day light side of the earth is noticed in contrast to the aurora found in dark night side of the earth.

The author notes briefly about a non-natural dark red sky found not in or inside of the aurora oval but in the subtropical zone on the ocean. The author wishes to have a more advanced contribution for realizing the aurora in the next following age.

### 2. SOLAR PLASMA FLOW

The solar plasma flow is propagates as a reflection of the solar activity. The author has his understanding that the solar activity is evaluated after monitoring the variations of the surface of the sun facing the earth. The details of the mechanism of the solar activity are not yet clear even in a scope of science though the eleven years solar cycle is strongly effective to the earth surface variations.

It has been aware the effect of the solar activity or of solar wind. Chapman [2] had given us the new term of “solar plasma” instead of the solar wind. The term “solar plasma” is expressing itself the scientific specific pattern of the solar wind in relation to geomagnetism and aurora.

### 3. AURORA IN DAY LIGHT SIDE

In this work, a note is introduced for problems on monitoring aurora in day light side of the earth in relation to the solar plasma flow. The solar plasma flow (the solar wind) distorts the geomagnetic field to form a magnetopause (cf. Figure 1).

By this time the aurora scientists have believed that the solar plasma flow (the energy of the electron – ca 50 eV or 50 electron Volt) at a super high speed so that a shock front is appeared just outside of the magnetosphere. It has been monitored the aurora in the day light side of the earth after the energy of the electron increased between the shock front and the magnetopause (ca 100 eV). This electron is the trigger of the red aurora (630.0 nm). On the basis of the surveys it is clarified that the polar cusp is a guide of the intruding electron of the solar plasma along the magnetic line into the upper atmosphere of the earth as shown in Figure 1. This red aurora is induced after energy release of the oxygen at the altitude of 200 km or more above the earth surface at intruding electron (ca 500 km/sec). Now, it should be noticed that the energy release of the electron to activate the oxygen atom is an order of several KeV in the visible aurora curtain (557.7 nm) found in the dark night side of the earth.

### 4. ALTITUDE OF AURORA

It is said that the altitude of the aurora boreares is depending on the incident electron out of the solar plasma into the polar oval zone as a aurora electron. An empirical result has been introduced as shown in Figure 2 in order to see what is the critical altitude of the aurora electron intrusion in a diagram of the critical altitude  $H$  above the earth surface and the counted number  $N$ (per cubic-cm second) of the ionized gas particles by the energy of the aurora electron ( $1/\text{cm}^2$ ).

The author has to consider here what process is possible to release the aurora energy for the bright light line in the visible band at applying technique of spectroscopy.

The aurora electron at the critical altitude surely must have exhausted so that no energy can be effective to ionize or activate the gas particles in the atmosphere for making a bright light line of spectroscopy in the visible band.

The aurora scientists seems to consider that the aurora electron affects directly to transfer energy to the atoms and the molecules of oxygen and nitrogen in order make the visible bright light. The author is unfortunately the details of the illustration shown in Figure 2. The aurora electron should be exhausted at the critical altitude just neighbor the earth surface.

### 5. AURORA IN VISIBLE BAND

Adding to the above, the bright line band noted the above section seems not to be consistent to what had been observed and recorded in any color print on the hard copy.

As far as the author concern, it should be considered that the aurora electron transferred to the hydrogen molecules for ionization and activation first. When the ionized

and activated hydrogen release its energy, the visible light must be seen as the specific bright light line in the spectroscopic analysis. This bright light line has to have the specific one for the related hydrogen. As for the hydrogen, four visible bright light lines are known.

Introducing the bright light line of spectrum for the ionized hydrogen, it is understood to be a more consistent relation between the aurora observed optically and the bright light line of spectrum of the interested hydrogen.

For a convenience, the four bright light lines for the hydrogen is introduced as follow:

Balmer Series	Wave Length (nm)	Color	Band Zoning
	—	Infra-Red Band	(770 nm< )
Hydrogen – $\alpha$ (1)	656.285	Red-Band Zone	(770-640 nm)
– $\alpha$ (2)	656.273	Red-Band Zone	(770-640 nm)
	—	Orange-Band Zone	(640-590 nm)
	—	Yellow-Band Zone	(590-550 nm)
	—	Green-Band Zone	(550-490 nm)
– $\beta$ (3)	486.133	Blue-Band Zone	(490-430 nm)
– $\gamma$ (4)	434.047	Blue-Band Zone	(490-430 nm)
	—	Violet-Band Zone	(430-380 nm)
	—	Infra-Violet Band	(380 nm> )

In the case of solar quiet day, the red aurora in the day-light side appears by chance. No detail is known even at present.

In the case of the solar burst, the strong disturbances are found in the aurora pattern, in the ionosphere behaviour, and in the geomagnetic field, which is called as “storm” [3].

## 6. MAN-MADE AURORA

The author here introduces one case of the non-natural energy release producing a similar pattern to the red aurora found in or inside of the aurora oval in the subtropical zone of the ocean.

After what is reported by Charles Day [4], his head-line of the report is like that “A high-altitude nuclear explosion would swell the radiation belt and imperil the global positioning system and other satellites. VLF transmission could forestall the damage”.

A happening was as follows. Day introduced that was on 1962 July 9. No solar storm has jolted the earth's inner radiation belt more than the nuclear test. On that day, the US exploded a 1.4 megaton nuclear warhead 400 km above Johnston Atoll, a remote group of the Pacific Islands. In Hawaii, 1400 km away, it was lit up the sky, knocked out street lights, triggered burglar alarms, and fused power lines (cf. Figure 3). Beta particles from the blast flooded the thin upper reaches of the atmosphere. Trapped by earth's magnetic field, the high-energy particles swelled the inner radiation belt. Seven satellites were damaged or put out of action. The radiation took more than a decade to dissipate. Alarmed by the unintended consequences, the nuclear powers banned testing in and above the earth's atmosphere in 1965. Some related notice could be obtained in Geophysical Research Letters (Vol.35, L09101, 2008) written by J.-A.Sauvaud, R.Maggiolo, C.Jacquay, M.Parrot, J.-J.Berthelier, R.J.Gamble, and C.J.Roger.

Even this case of the man-made auroras, the process is same in the scope of science.

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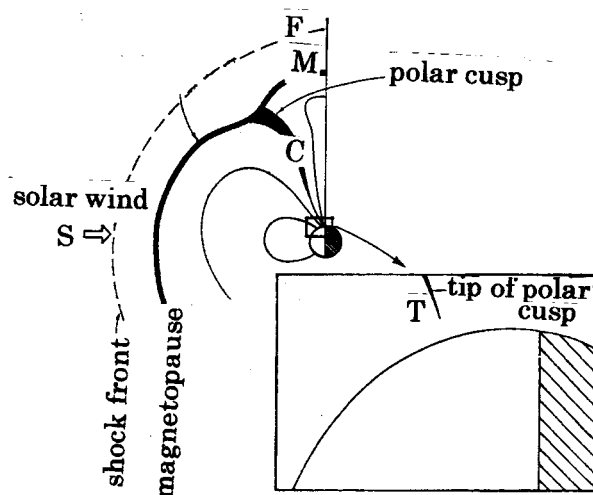


Figure 1 Structure between solar plasma flow and polar tip.

- (1) solar plasma flow for S,
- (2) shock front for F,
- (3) magnetopause for M,
- (4) polar cusp for C,
- (5) tip of polar cusp for T (inset).

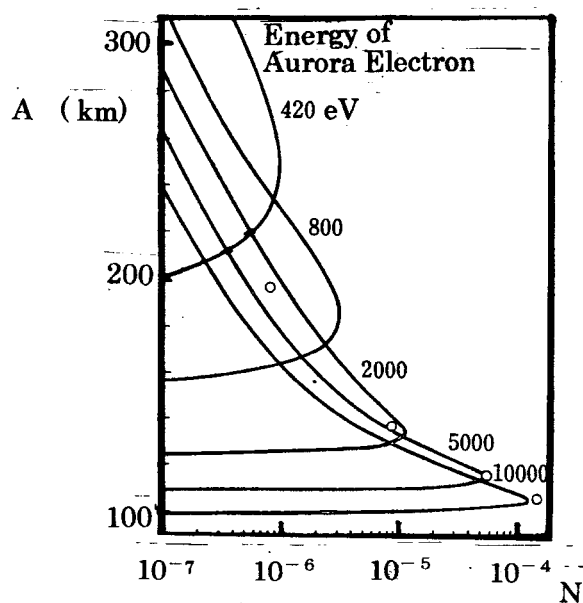


Figure 2 Count number of gas particles ionized by aurora electron.

- (1) N—for number of ionized gas particle (number per cubic cm-sec),
- (2) A—for altitude above the earth surface (km),
- (3) Parameter—for energy of aurora electron (electron Volt = eV).





Figure 3 Glowing red sky after a nuclear test.  
(1) Glowed red sky over Honolulu in Hawaii,  
( 1400 km away),  
(2) Nuclear test – 400 km above Johnston Atoll,  
( on 1962 July 9 ),  
(3) X-rays from the nuclear test excited atomic oxygen  
In the upper atmosphere (Thermosphere).  
[ by the courtesy of USAF.]



## APPENDCES

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- 2009h S.Nakamura Monitoring of satellite thermal pattern of an ocean front as a hydrodynamic convergence, PERS2009 Proceedings, 18-21 August 2009, Moscow, Russia, pp.971-974.
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2010 April 01

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1992- Fellow, Royal meteorological Society, UK

2004- Fellow, PACON International (Univ.Hawaii), Honolulu, Hawaii, USA

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2008-Gratis Member, European Geosciences Union

**Prize and Honours:**

1983- Prix de la Franco-Japonaise Societe de Oceanographie, Tokyo, Japan

**Published materials: Academic papers in Scientific Journals, Proceedings, and others****Scientific Books(Japanese and/English) including "e-Books"****[search Nakamura in the Web-sites, ->><http://www.piers.org>****and/or ->><http://repository.kulib.kyoto-u.ac.jp/dspace> ]****Recent Interests: Satellite monitoring for earth science, Electromagnetism,  
Ocean Sciences, Radiations, Natural Hazards, Civil Engineering**

I, as Shigehisa Nakamura, declare that my curriculum vitae are correct as seen above.

Shigehisa Nakamura

# INTERNATIONAL ACTIVITY – Shigehisa Nakamura

2010Apr01

1. 71Aug01-71Aug19 IUGG General Assembly, Moscow, USSR
2. 72Aprx1-72Aprx2/a Congress on Ocean Development, Keidanren, Tokyo#
3. 74Jan25-74Feb03 IUGG Tsunami Symposium, Wellington, NZ
4. 77Mar21-77Apr01 IUGG Tsunami Symposium Ensenada, Mexico
5. 78Jun10-78Oct10 \*Visiting Senior Fellow, Hawaii Univ., HIG, Hon, HI
6. 79Aug24-79Sep05 Pacific Science Congress, Khabarovsk, USSR
7. 80Jul26-81Jan21 \*Visiting Scientist, CSIRO Perth(Div.LRM), Australia
8. 82Aug15-82Aug22 Tsunami Soc., Honolulu, Hawaii, USA
9. 83Aug13-83Aug28 IUGG General Asembly, Hamburg, West Germany
10. 84Dec09-84Dec15 Seminar/Workshop on Preparedness for Geologic Disasters in Southeast Asia and the Pacific Region, Manila, Philippines
11. 85Aug03-85Aug09 Joint Assembly IAMAP/IAPSO, Honolulu, HI, USA
12. 87Aug16-87Aug24 IUGG General Assembly, Vancouver, Canada
13. 88Mar18-88Mar25 European Geophysical Society(EGS) General Assembly, Bologna, Italy
14. 88Nov14-88Nov21 NOAA Int.Conf.on Tidal Hydrodynamics(NBS/NIST) Gaithersburg, MD, USA
15. 91Aug17-91Aug24 IUGG General Assembly, Wien, Austria
16. 91Sep20-91Oct05 Int.Workshop 'Waves and Vortices in the Ocean and their Laboratory Analogues, Vladibostok, Russia
17. 92Apr06-92Apr10 EGS General Assembly, Edinburg, UK
18. 92Jun01-92-Jun05 Pacific Congress on Marine Science and Technology, (PACON), Kona, Hawaii, USA
19. 93Jun13-93Jun18 PACON93 China Symposium, Beijing, China
20. 94Jul02-94Jul09 PACON94, Townsville, Queensland, Australia
21. 94Sep20-94Sep27 International Symposium on Marine Positioning 1994 (INSMAP94), Hannover, Germany
22. 95Apr02-95Apr09 EGS General Assembly, Hamburg, Germany
23. 95Jun05-95Jun10 Int.Workshop 'Boundary Effects in Stratified and/or Rotating Fluids', Sankt-Peterburg(Pushkin-Tsarskoi Selo), Russia
24. 95Aug09-95Aug14 IAPSO(IUGG) General Assembly, Hon, HI, USA
25. 96Mar04-96Mar10 Oceanology International 96, Brighton, UK
26. 96Jun17-96Jun23 PACON96, Honolulu, Hawaii, USA
27. 96Jul20-96Jul26 AGU-WPGM'96, Brisbane, Australia

- 28.96Aug12-96Aug18 Pacific Ocean Remote Sensing Conf.(PORSEC96),  
Victoria, BC, Canada
- 29.97May10-97May14 Oceanology International 97 Pacific Rim, Singapore
- 30.97Jun30-97Jul04 Joint Assembly IAMAS/IAPSO, Melbourn, Australia
- 31.98Jul21-98Jul24 AGU-WPGM'98, Taipei, Taiwan
- 32.98Jul27-98Jul31 PORSEC98, Quindao, China
- 33.98Oct12-98Oct15 ICHD98, Seoul, Korea
- 34.99Mar22-99Mar26 PIERS1999, Taipei, Taiwan
- 35.99Jul19-99Jul24 IUGG99 General Assembly, Birmingham, UK
- 36.00Mar25-00Apr01 ISRE(Int.Sym.Remote Sensing Env.), Cape Town, SA
- 37.00Dec03-00Dec08 PORSEC2000, Panaji, Goa, India
- 38.01Jul08-01Jul12 PACON2001(Jul8-11), Burlingame, Calif., USA
- 39.01Jul15-01Jul19 IAMAS2001(Jul.10-18), Innsbruck, Austria
- 40.02Feb11-02Feb15 AGU-Ocean Sciences 2002, Honolulu, Hawaii, USA\*
- 41.02Jul01-02Jul05 PIERS2002, Cambridge, MA, USA
- 42.02Jul21-02Jul26/b PACON2002, Makuhari, Chiba#
- 43.03Jun30-03Jul11/c IUGG2003, Sapporo, Hokkaido#
- 44.03Oct12-03Oct16 PIERS2003, Honolulu, Hawaii, USA
- 45.03Nov30-03Dec03 PACON2003, Kaoshiung, Taiwan
- 46.04May30-04Jun04 PACON2004, Honolulu, Hawaii, USA
- 47.04Aug15-04Aug21 ICTAM2004, Warsaw, Poland\*
- 48.04Aug28-04Aug31 PIERS2004, Nanjing, China
- 49.05May23-05May27 AGU Joint Assembly, New Orleans, LA, USA\*
- 50.05Aug23-05Aug26 PIERS2005, Hangzhou, China
- 51.06Mar26-06Mar31 PIERS2006, Cambridge, MA, USA
- 52.06Jul24-06Jul27 AGU-WPGM, Beijing, China\*
- 53.07Mar26-07Mar30 PIERS2007, Beijing, China
- 54.07Aug27-08Aug30 PIERS2007, Prague, Czech
- 55.08Mar24-08Mar28 PIERS2008, Hangzhou, China
- 56.08Apr13-08Apr18 EGU2008 General Assembly, Vienna, Austria
- 57.09Mar23-09Mar27 PIERS2009, Beijing, China
- 58.09Apr19-09Apr24 EGU2009, General Assembly, Vienna, Austria

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